

ADDITIONAL FEES:

Submitted herewith is a check in the amount of \$584.00 to cover the additional fee for one (1) extra independent claim and seven (7) claims in excess of those already paid for. Should the check prove insufficient for any reason or should an additional fee be due, authorization is hereby given to charge any such deficiency or additional fee to our Deposit Account No. 01-0268.

REMARKS

In the last Office Action, claims 1, 12 and 13 were rejected under 35 U.S.C. §102(b) as being anticipated by Veillette (US 3,937,533). Claims 17, 18, 22 and 24 were rejected under 35 U.S.C. §103(a) as being unpatentable over combinations of the references to Veillette, Boon (US 5,227,948) and Omori (US 6,644,938).

In accordance with the present response, independent claim 1 has been amended to further patentably distinguish from the prior art of record and to improve the wording. New claims 25-35 have been added to provide a fuller scope of coverage. The specification has been revised to bring it into better conformance with U.S. practice. A new abstract which more clearly reflects the invention to which the amended claims are directed has been substituted for the original abstract.

New claims 25-35 are readable on the elected species. Independent claim 27 is generic to both species I and II identified by the Examiner in the May 26, 2009 Office Action. The claims drawn to non-elected species have been retained pending allowance of this or any other generic or sub-generic claim.

Applicant requests reconsideration of his application in light of the foregoing amendments and the following discussion.

The present invention is directed to a magnetic bearing device and to a turbo molecular pump having the magnetic bearing device.

As described in the specification, conventional magnetic bearing devices for turbo molecular pumps have not been capable of reducing a detection error at the time of detecting a current flowing through electromagnets of the magnetic bearing devices. Such conventional magnetic bearing devices also require a large number of circuit elements required for driving the electromagnets through excitation. Accordingly, the conventional magnetic bearing devices cannot be downsized and are associated with high production cost, failure rate and power consumption.

The present invention overcomes the drawbacks of the conventional art. Figs. 1-4 show an exemplary embodiment of a magnetic bearing device according to the present invention embodied in the claims. The magnetic bearing device has a rotor 103, a plurality of electromagnets 104 for controlling a radial position and/or an axial position of the rotor 103, a power source 153 for supplying power to the electromagnets, a common node C commonly connected to each one end of the electromagnets 104, switch means 280 for switching a voltage of the common node C, and excitation control means (e.g., 150) for controlling excitation of each of the electromagnets 104 by a supply current that flows through the electromagnets 104 in one

direction or a regenerated current that flows through the electromagnets 104 in one direction.

The switch means 280 includes a first switch element 281 for connecting and disconnecting between one end of the power source 153 and the common node C, and a first rectifier element 285 connected between the other end of the power source 153 and the common node C. The excitation control means includes a second switch element 261 for connecting and disconnecting between the other end of one of the electromagnets 104 and the other end of the power source 153, and a second rectifier element 265 connected between the other end of one of the electromagnets 104 and the one end of the power source 153.

By the foregoing construction and corresponding functions, the present invention provides a magnetic bearing device capable of reducing a detection error at the time of detecting a current flowing through the electromagnets of the magnetic bearing devices. Furthermore, by structuring the magnetic bearing device according to the present invention such that the supply current or the regenerated current flows in one direction, the overall number of components for the switch means and the excitation control means is reduced. As a result, the magnetic bearing device can be downsized and has low production cost, failure rate and power consumption as compared to the conventional art.

Applicant respectfully submits that amended independent claim 1, dependent claims 12, 13, 17, 18, 22, 24, and new claims 25-35 patentably distinguish from the prior art of record.

Claims 1, 12 and 13 were rejected under 35 U.S.C. §102(b) as being anticipated by Veillette. Applicant respectfully traverses this rejection.

Amended independent claim 1 is directed to a magnetic bearing device and requires excitation control means for controlling excitation of each of the electromagnets by a supply current that is supplied from the other end of one of the electromagnets to a negative electrode of the power source and that flows through the electromagnets in one direction, or by a regenerated current that is regenerated from the other end of one of the electromagnets to a positive electrode of the power source and that flows through the electromagnets in one direction. Claim 1 further requires that the excitation control means includes a second switch element for connecting and disconnecting between the other end of one of the electromagnets and the negative electrode, and a second rectifier element for causing a current to flow from the other end of one of the electromagnets to the positive electrode. No corresponding structural and functional features are disclosed or described by Veillette.

Veillete discloses a magnetic bearing device capable of controlling the position of a rotor 14 in the axial direction while adjusting the rigidity of the rotor 14 in the radial direction (Fig. 1). A permanent magnet 6 located between a rotor radial extension 42 and a rotor radial extension 44 produces a constant bias flux Φ_1 , while a permanent magnet 8 located between the rotor radial extension 44 and a rotor radial extension 46 produces a constant bias flux Φ_2 . The constant bias flux Φ_1 passes through a gap 22 and a sharp pole piece 36b of a stator 12, while the constant bias flux Φ_2 passes through a gap 24 and a sharp pole piece 40a of the stator 12. A coil N1 is wound on the stator 12 to produce a flux Φ_3 by the current flowing into the coil N1, while a coil N2 is wound on the stator 12 to produce a flux Φ_4 by the current flowing into the coil N2. The magnitude and direction of the fluxes Φ_3 and Φ_4 are changed to increase or cancel the magnitude of the constant bias fluxes Φ_1 and Φ_2 , respectively, by which the magnitude of the fluxes passing through the gap 22 and the gap 24 is changed. As a result, the rigidity of the rotor 14 in the radial direction can be adjusted and the position of the rotor 14 in the axial direction can be controlled.

Veillete shows in Fig. 2 that a current L_1 flowing into the coil N1 and a current L_2 flowing into the coil N2 are directed in the positive direction and the negative direction, respectively. Accordingly, a bridge circuit is formed of switch

elements T1, T2, T4 and T5 arranged for the coil N1 and switch elements T2, T3, T5 and T6 arranged for the coil N2, as noted by the Examiner in the circuit diagram on page 4 of the Office Action.

Thus, Veillette requires the switch elements as denoted by the Examiner in the circuit diagram on page 4 of the Office Action to allow the current to flow in two directions, i.e., in the positive and negative directions. In contrast, amended independent claim 1 requires excitation control means for controlling excitation of each of the electromagnets by a supply current that is supplied from the other end of one of the electromagnets to a negative electrode of the power source and that flows through the electromagnets in one direction, or by a regenerated current that is regenerated from the other end of one of the electromagnets to a positive electrode of the power source and that flows through the electromagnets in one direction. Stated otherwise, in Veillette the current flows bi-directionally (i.e., in two directions), while amended claim 1 requires a supply current or a regenerated current that flows unidirectionally (i.e., in one direction).

Since Veillette does not disclose or describe a supply current or a regenerated current that flows through the electromagnets in one direction, the reference cannot anticipate amended independent claim 1. W.L. Gore & Associates v. Garlock, Inc., 220 USPQ 303, 313 (Fed. Cir. 1983), cert. denied, 469 U.S.

851 (1984) ("Anticipation requires the disclosure in a single prior art reference of each element of the claim under consideration"). Furthermore, Veillette does not suggest the claimed subject matter and, therefore, would not have motivated one skilled in the art to modify Veillette's magnetic bearing device to arrive at the claimed invention.

Claims 12 and 13 depend on and contain all of the limitations of amended independent claim 1 and, therefore, distinguish from Veillette at least in the same manner as set forth above for amended independent claim 1.

In view of the foregoing, applicant respectfully requests that the rejection of claims 12 and 13 under 35 U.S.C. §102(b) as being anticipated by Veillette be withdrawn.

Claims 17, 18, 22 and 24 were rejected under 35 U.S.C. §103(a) as being unpatentable over combinations of the references to Veillette, Boon and Omori. Applicant respectfully traverses these rejections.

Veillette does not disclose or suggest the structural and functional combination of the magnetic bearing device recited in amended independent claim 1 as set forth above for the rejection under 35 U.S.C. §102(b). Claims 17, 18, 22 and 24 depend on and contain all of the limitations of amended independent claim 1 and, therefore, distinguish from Veillette at least in the same manner as set forth above for amended independent claim 1.

The references to Boon and Omori do not disclose or suggest, either alone or in combination, the excitation control means and corresponding structure and functions recited in amended independent claim 1, from which claims 17, 18, 22 and 24 depend. Accordingly, Boon and Omori do not cure the deficiencies of Veillette, and one ordinarily skilled in the art would not have been led to modify the references to attain the claimed subject matter.

In view of the foregoing, applicant respectfully requests that the rejection of claims 17, 18, 22 and 24 under 35 U.S.C. §103(a) as being unpatentable over combinations of the references to Veillette, Boon and Omori be withdrawn.

Applicant respectfully submits that new claims 25-35 also patentably distinguish from the prior art of record.

New independent claim 27 is directed to a magnetic bearing device and requires a rotor, a plurality of electromagnets that control a radial position and/or an axial position of the rotor, a power source that supplies power to the electromagnets, a common node commonly connected to each one end of the electromagnets, and a switching circuit that switches a voltage of the common node, the switching circuit including a first switch element that connects and disconnects between one end of the power source and the common node, and a first rectifier element connected between the other end of the power source and the common node. Claim 27 further requires an

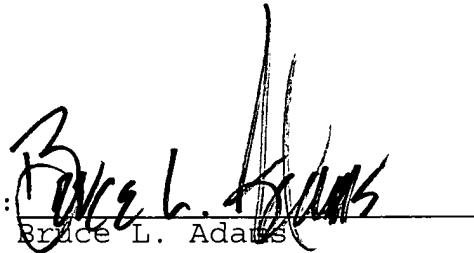
excitation control circuit that controls excitation of each of the electromagnets by a supply current that flows through the electromagnets in one direction or a regenerated current that flows through the electromagnets in one direction, the excitation control circuit including a second switch element for connecting and disconnecting between the other end of one of the electromagnets and the other end of the power source, and a second rectifier element connected between the other end of one of the electromagnets and the one end of the power source. No corresponding structural and functional features are disclosed or suggested by the prior art of record as set forth above for amended independent claim 1.

New claims 25-26 and 28-35 depend on and contain all of the limitations of amended independent claim 1 and new independent claim 27, respectively, and, therefore, distinguish from the prior art of record at least in the same manner as set forth above for independent claims 1 and 27.

In view of the foregoing, favorable reconsideration and passage of the application to issue are most respectfully requested. In the event that the Examiner determines that something further need be done to place the application in allowable form, it is respectfully requested that the Examiner telephone the undersigned attorney at the below-listed number whereupon any outstanding matter will be promptly attended to.

Respectfully submitted,

ADAMS & WILKS
Attorneys for Applicant

By: 

Bruce L. Adams
Reg. No. 25,386

17 Battery Place
Suite 1231
New York, NY 10004
(212) 809-3700

MAILING CERTIFICATE

I hereby certify that this correspondence is being deposited with the United States Postal Service as first-class mail in an envelope addressed to: MS AMENDMENT, COMMISSIONER FOR PATENTS, P.O. Box 1450, Alexandria, Virginia 22313-1450, on the date indicated below.

Donna Riccardulli

Name



Signature

NOVEMBER 13, 2009

Date